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the Metropolitan Museum and of Fossil Fishes in the American Museum, a member of this Committee, has designed effective models for new armor which are now being manufactured for trial in actual field operations.

8. The hope of the Committee has been to attach a geologist in an advisory capacity, to each military unit of large size. This end has not yet been attained; some geologists, former members of Officers Training Camps, hold commissions in France with the Commanding General; a number are now in active service here, and under instructions from the Secretary of War, a list has been compiled of all geologists willing to accept commissions in any department of the Army. This list is a large one and the intimations of the Secretary of War are that, as the military activities develop, additional calls will be made for active field service by the geologists.

9. The 'Plan of Service' submitted by the Committee has now been approved, in general, by the Engineer Officers and the Secretary of War. This plan of service laid special emphasis on the importance of our ability to interpret soil and rock conditions in relation to trenchability, tunneling, and the location and control of ground water.

J. M. Clarke, *Chairman*
W. W. Atwood
C. P. Berkey
A. L. Day
Bashford Dean
F. W. DeWolf
W. O. Hotchkiss
E. B. Mathews
J. C. Merriam
R. A. F. Penrose, Jr.
H. F. Reid
C. R. Van Hise
C. D. Walcott
J. B. Woodworth

NATIONAL RESEARCH COUNCIL

FIRST REPORT OF COMMITTEE ON ZOOLOGY

1. *Organization of Committee.*—In organizing the Committee on Zoology the attempt has been made to select its members so as to represent various branches of Zoological research as well as different sections of the country and at the same time not to have the Committee so large or so widely scattered as to be unworkable. The Zoological Committee of the Committee of One Hundred on Scientific Research of the American Association for the Advancement of Science was incorporated in the present Committee on Zoology and a few other persons were added. As the work develops it is expected that other members will be added to the Committee and that Sub-committees will be formed in special branches of the science. At the present time the membership of the Committee on Zoology consists of the following persons, whose addresses and principal scientific interests are given after their names:

D. G. Conklin, *Chairman,* Princeton University, Embryology, Cytology.

S. A. Forbes, University of Illinois, Entomology, Ichthyology, Ornithology.

C. A. Kofoid, University of California, Protozoology, Parasitology.

F. R. Lillie, University of Chicago, Embryology, Marine Biology.

T. H. Morgan, Columbia University, Experimental Zoology, Genetics.

G. H. Parker, Harvard University, General Zoology, General Physiology.

J. Reighard, University of Michigan, Ecology, Ichthyology.

H. M. Smith, Commissioner of Fisheries, Washington.

As now constituted, the Committee represents predominantly pure zoology as contrasted with applied and universities rather than technical institutions. This is due in part to the fact that there has hitherto been a greater lack of cooperation and organization in pure zoology than in applied and in part to the facts that applied science must be developed on a foundation of pure science and that universities must supply most of the investigators for all lines of scientific research. Many zoological subjects of economic importance, not now represented directly on this Committee, are organized under separate bureaus, divisions or surveys of the general Government or of the several States—such as the United States Bureaus of Animal Industry, Biological Survey, Entomology, Fisheries, and the Agricultural and Biological Stations and the Fish and Game Commissions of the various States. Furthermore, the Committees of the Research Council on Agriculture, Medicine, and Physiology deal with many problems which are essentially zoological. Many zoological investigators are at work in fields occupied by these different organizations and to a large extent the work and the workers which are left to the Committee on Zoology represent the residue of zoological science after these more practical subjects have been taken away.

Our Committee has attempted to establish cooperative relations with many of these organizations and to avoid conflicts with all of them. Wherever work is already being done by any existing organization it is the desire of the Committee on Zoology to assist in that work in any way possible and not to duplicate it. The members of the Committee are in contact with or have knowledge of the majority of the zoological investigators of this country and in many cases it would be possible for the Committee to recommend to these National or State organizations investigators or students for particular lines of work or to find laboratory facilities for the investigation of special problems.

2. *Suggestions for National Service.*—During the war the immediate needs of the nation take precedence over all other aims and the practical and economic applications of research must to a large extent supersede the extension of knowledge for its own sake. Many zoologists have turned from their customary duties to some form of national service; several are doing important work with the Food Administration, others have taken up research work in some of the governmental bureaus or State Commissions, still others have

offered their services to the nation through the Committee on Zoology. In response to many inquiries from zoologists as to how they might be of service in this national emergency the Committee on Zoology published in *Science*, volume 45, number 1173, "Some Suggestions for National Service on the Part of Zoologists and Zoological Laboratories," from which the following is extracted with certain modifications and additions:

The greatest national service which the biological sciences can render in war as well as in peace is in conserving human life, in protecting and improving useful animals and plants, and in controlling or destroying injurious ones; when it is remembered that practically everything which we eat or wear comes from animals or plants it will be realized that this last is no slight service.

Many of the practical and economic branches of biology have long been well organized for public service and this applies particularly to medicine, sanitation and agriculture; in each and all of these branches the trained zoologists may render valuable aid. Probably no other non-medical men are better prepared by training and no other institutions better fitted by equipment to assist in medical and sanitary work than are zoologists and zoological laboratories, and in the matter of the propagation and improvement of useful animals and the destruction of useless or injurious ones zoologists should be especially at home. In many instances zoologists who have hitherto confined their attention to theoretical and general problems would need to turn their attention to new lines of work, but it can not be doubted that experience in solving general and theoretical problems would be of great value in dealing with special and practical ones.

3. *Sanitary Work.*—(*a*) Much sanitary work is primarily zoological as, for instance, the study of the life histories of parasitic protozoa, tapeworms, flukes, roundworms, insects, mites, etc., together with methods of their control or eradication.

(*b*) The elimination or control of animal pests, which are often carriers of disease-germs, such as flies, mosquitoes, bugs, lice, rats, etc.

(*c*) Assistance in medical diagnosis, as in the microscopical or chemical examination of blood, urine, feces, sputum, etc.

(*d*) Microscopical or chemical examination of water and soil of camp-sites, drainage-areas of cities, etc.

(*e*) The zoological aspects of the collection and disposal of garbage and sewage.

(*f*) "The effects of sewage contamination upon the system of life and hence upon the economic productivity of specific waters, especially of important rivers, and a program of management, calculated to gain and retain whatever economic advantages, and to avoid whatever disadvantages, the contamination of streams by sewage may involve or entail." (Letter from S. A. Forbes.)

In view of the importance of zoological science in dealing with old and new problems which will arise in connection with sanitation, it would be very desirable to have at least one trained zoologist connected with the medical staff of each mobilization camp.

4. *Agricultural Work.*—(*a*) Application of principles of heredity to the improvement of breeds of domestic animals.

(*b*) Study of physiology of reproduction with a view to increasing productivity in animal breeding; for example, improved methods of incubation, brooding and rearing of fowls; better methods of increasing egg laying, especially during winter months; the serious problems of abortion in cattle, small litters and destruction of young among swine, etc.

(*c*) Determination of standards of feeding and care of domestic animals for best general or specific results and for greater economy.

(*d*) Cooperation with the agricultural agencies of the states and nation in the elimination of animals which prey upon or are parasitic upon domestic animals; of animal pests destructive to crops, fruits, forests,—to stored vegetables, grains and other food supplies,—to clothing, woodwork and other manufactured products. The annual losses due to such animal pests are probably not less than the enormous taxes levied for the prosecution of the war; here is a perennial tax which would relieve us of all national taxation if it could be saved and applied to that purpose; here are problems which call for research work of the highest order and for an army of investigators.

(*e*) The protection of insectivorous birds and the propagation of enemies of injurious insects. It is estimated that in Kansas alone the annual preventable damage to food crops amounts to thirty million dollars. The largest natural elements in the prevention of this loss are ground-nesting birds. Migratory birds should be protected by the passage of the "Migratory Bird Treaty Act."

In this connection the Chief of the Biological Survey has written:

"The National Stock Growers Associations estimate that the annual losses in live stock from predatory animals in the Western United States amount to from $12,000,000 to $15,000,000. The directors of extension work in the Western States estimate that the losses in cereal and other crops through depredation of noxious rodents in the four states of Montana, North Dakota, Kansas and California, amount to between $50,000,000 and $60,000,000. I have determined that, at a conservative estimate, the damage done by house rats each year amounts to $200,000,000. This involves the continuous labor of more than 200,000 men. This is entirely apart from the very serious losses and deaths through the disease carrying proclivities of these animals. The work of conserving and increasing our migratory birds through the Migratory Bird Treaty with Great Britain is another important activity of this Bureau. The Canadian Government is now proceeding to secure enactments necessary to make the Migratory Bird Treaty effective on the recommendation from Government officials that to do so will assist in protecting the crops through the better protection of insectivorous birds."

5. *Better Utilization of Wild Animals.*—(*a*) Preservation, propagation and domestication of useful wild animals. The game resources of the country can be fostered and enormously increased with intelligent effort in the right direction, thus adding not only to the pleasure and health of a large number of people, but distinctly increasing the national wealth by enlarging the food supply. The fur trade could once more be made a great national industry. Some useful animals, now wild, could be brought into captivity or domesticated and by selective breeding could be greatly improved. Probably certain useful birds and mammals of other countries might be imported under proper precautions.

(*b*) Exploitation and propagation of useful marine and fresh-water animals in cooperation with the Bureau of Fisheries. There is an unlimited supply of food in the oceans of the world and we have scarcely begun to reap the "harvest of the seas." Countless forms of fishes, crustacea, mollusks and other types which are not now generally used as food are both wholesome and delicious when properly prepared. The Commissioner of Fisheries says:

"Zoologists may perform a service by bringing to the attention of people, in the course of their conversations, lectures, etc., the reasons for looking to the fisheries for increased food supply, the wholesome character of the meat, the economy with which fish are produced without dependence upon agriculture for their food. Many new fishes are being introduced into the market,—sharks, howfin, burbot, sable-fish and others,—and it is certain that zoologists can do a good service in helping to overcome popular inertia that will be encountered. The Bureau will gladly send circulars announcing new fishes to any who apply.

"The biological problems of fish ponds are numerous. Recently a college zoologist in association with the Bureau began giving special attention to the relation of dragon flies and damsel flies to fish culture in ponds. Already he has gained results that were unexpected, but that are highly significant. The larvae of dragon flies were known to prey upon fish fry, but this investigator finds that they also prey in greater measure upon other insects that are more effective enemies of fish fry; various other interesting interrelations are discovered. This is only an illustration of what may be done with various groups of aquatic and semi-aquatic animals and plants. Results of value may, in some cases, be obtainable in a brief space of time.

"We know very little about the parasites of fishes, their relative abundance under different conditions of environment, their life-histories and alternate hosts. Means of control can not be devised without more complete knowledge regarding particular species.

"We should be glad to advise either directly or through you with any zoologist who is considering a particular problem related to fisheries."

(*c*) Prof. S. A. Forbes suggests the following very important investigation: "The effect on the productivity of streams and their dependent waters traceable to operations for the agricultural reclamation of bottomlands, together with a plan for the management of our more valuable streams such as to compensate so far as practicable for the losses due to such reclamation. We have a problem of this kind on the Illinois River, the normal productivity of which has fallen off to about a third its former rate in consequence of diking and drainage operations on its bottomlands; and I have been unable to find any agency, either state or national, in position to handle effectively the practical problem of the managment of the stream and the development of the resources remaining after this inevitable reclamation process has gone to its limit. It is primarily a fisheries problem and all aware of the facts admit that it should be worked out, but neither State nor United States fisheries commissions are able to undertake it. The consequence is a considerable and increasing loss of food to the country at large, since the product of this stream is disposed of chiefly in the principal cities of the eastern United States."

6. *Educational and Social Work.*—(*a*) Thorough studies of human heredity as a necessary preliminary to any attempt to permanently improve our human stock and increase our national efficiency.

(*b*) The teaching of zoology may be made an especially important means of promoting national intelligence, cooperation and welfare, for in many respects zoology comes nearer to man and his problems than does any other physical or natural science; it is indeed the foundation or background of human studies, since man also is an animal. There are many important lessons for mankind in the heredity, development, evolution and adaptations of animals as well as in the organization of animal states.

(*c*) The laying of broad zoological foundations for medical education and research must always be an important part of the work of the zoologist. While the present demands on medical men continue zoologists would be well qualified to assist in the more fundamental subjects of medical education, especially in anatomy, histology, embryology and neurology.

(*d*) The prosecution of research work, whether in pure or applied science, is a national duty of the first magnitude; the continuance of research work in zoology, and especially of work already begun which cannot be interrupted without serious loss to science, is a real national service.

7. *Miscellaneous Problems.*—In addition to these general lines of work the following special problems have been suggested:

(*a*) The microscopical inspection of food, clothing and supplies.

(*b*) Studies of the coat coverings of animals with a view to the utilization of nature's principles in making the clothing of soldiers light, warm, well-ventilated, impervious to water and protectively colored.

(*c*) Studies of the mechanism of aquatic and aërial locomotion in animals with reference to its application to submarines and aëroplanes.

(*d*) Utilization of gulls and other aquatic birds in locating submarines.

(*e*) Studies of the mechanisms of limbs and joints with a view to offering suggestions in the construction of artificial limbs.

(*f*) Investigation in tissue cultures, grafting and regeneration, with a view to their surgical applications.

(*g*) The protection of submerged timbers from depredations of ship worms and the prevention of the fouling of ship bottoms by attachment of marine organisms.

8. *Activities of the Committee on Zoology.*—In carrying out some of these suggestions members of the Committee have recommended to the Government investigators trained in the study of certain important human parasites which are not widely known; one member of the Committee has offered his services for the study of intestinal flagellates which cause trench diarrhea; zoologists trained in microscopical technique and parasitology have been sent into medical and hospital service. The suggestion that at least one zoologist especially familiar with animal parasites should be assigned to the Medical Staff of each mobilization camp has not been acted upon so far, but it seems to the Committee that this should be done as soon as possible.

Some zoologists and zoological students have been cooperating in the campaigns against animal pests which have been organized by the Bureau of Entomology, the Biological Survey and by Commissions of certain States. Others have been employed by the Bureau of Fisheries in exploiting new sources of marine food and in devising new methods of curing and preserving food fishes.

One member of the Committee has been making experiments in consultation with naval officers, on new methods of protecting ship bottoms from fouling due to the growth of marine organisms. Several zoologists have been interested in the problem of utilizing gulls in locating submarines. It seems probable that by feeding gulls from a submerged submarine, practically all of these birds along our coast could be trained within a brief time to hover over submarines and thus reveal their location. There is some reason to believe also that individual gulls could be trained to work from ships at sea to which they would return. In this connection the Commissioner of Fisheries writes: "The great success of the Japanese in training wild cormorants for the service of man should be borne in mind."

Finally, the members of the Committee in common with many other zoologists, have been actively engaged in research and in the promotion of research chiefly in non-applied lines. Probably the output of zoological research in this country was never greater and the facilities for carrying on such work were never better than in the year preceding our entrance into the war; nevertheless conditions in these respects can be greatly improved and the Committee on Zoology of the National Research Council considers that one of its main functions is to prepare for research work in all branches of zoology in the period after the war. To this end one of the first duties of the Committee will be to make a census of workers, laboratories, publications, fellowships, assistantships, etc., together with a list of the most general needs of research work in zoology. The Committee will undertake this work as soon as possible and in the meantime it invites from every zoological investigator in the country a statement of the things most urgently needed for the promotion of his own research work.

For the Committee, EDWIN G. CONKLIN, *Chairman.*

NATIONAL RESEARCH COUNCIL

THE SCOPE AND WORK OF THE BOTANICAL RAW PRODUCTS COMMITTEE

At the twenty-fourth meeting of the Executive Committee of the Council held on July 12, 1917, the appointment of a Botanical Raw Products Committee was approved. This committee has since been organized with Edward M. East, Chairman, and Oakes Ames, L. H. Dewey, H. M. Hall, Henry Kraemer, A. D. Little, George T. Moore, W. W. Stockberger and W. P. Wilson, members. It is designed to serve as a clearing house where manufacturers needing raw products of a botanical nature may obtain information regarding them. The scope of its work may be outlined somewhat as follows:

1. The collection of agricultural, botanical and commercial data on all species and varieties of plants having an economic value (exclusive of food staples).
2. Dissemination of such information among importers and manufacturers.
3. Investigation of requirements of the trade for known raw materials.
4. The discovery of new geographic sources of plants necessary to the trade.
5. The development of plans for meeting the needs of industry by the cultivation of economic plants in the United States.
6. The initiation of investigations calculated to discover the value of conventional equivalents and substitutes for raw products of a botanical nature.
7. The discovery and investigation of the value of new equivalents and substitutes.
8. The investigation of the requirements of the trade for new raw materials.
9. The suggestion of new species as possibly meeting trade requirements, and the initiation of the proper investigations as to whether or not they meet these requirements.
10. The suggestion of new uses for botanical raw products.

Owing to the magnitude of the work proposed, there being over 25,000 species and varieties of plants having an economic value (exclusive of agricultural and horticultural novelties), it would be some time before active work